Repetitive Transcranial Magnetic Stimulation (rTMS): An Educational Overview

Abstract
Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive brain stimulation technique that modulates neural activity through repeated magnetic pulses applied to targeted cortical regions. Clinically, rTMS has gained approval for treatment-resistant depression and is increasingly explored for neurological disorders such as post-stroke rehabilitation and mild cognitive impairment (MCI). This overview summarizes its mechanism, current clinical applications, supporting evidence, and patient considerations from a neurologist's perspective.

Introduction

rTMS works by delivering magnetic fields through a coil placed over the scalp, inducing small electrical currents in the brain. By repetitively stimulating specific cortical areas, rTMS can either enhance or inhibit neuronal excitability. Unlike electroconvulsive therapy (ECT), rTMS does not require anesthesia and is generally well tolerated, making it suitable for outpatient settings.

Clinical Applications

- **Major Depressive Disorder (MDD):** rTMS is FDA- and TFDA-approved for patients with treatment-resistant depression.
- **Stroke Rehabilitation:** Studies suggest rTMS may promote motor recovery by rebalancing interhemispheric inhibition.
- **Mild Cognitive Impairment (MCI) and Dementia Prevention:** Emerging trials investigate its potential in improving memory and cognitive function.
- **Other Neurological Conditions:** Applications such as chronic pain, tinnitus, and movement disorders are under ongoing research.

Research Evidence

- Lefaucheur J-P, et al. *Evidence-based guidelines on the therapeutic use of rTMS.* Clin Neurophysiol. 2020.
- Hu X, et al. *The effects of rTMS and tDCS on memory in mild cognitive impairment: a systematic review.* Front Aging Neurosci. 2024.
- Rossi S, et al. *Safety, ethical considerations, and application guidelines for rTMS.* Clin Neurophysiol. 2021.

These studies demonstrate that while rTMS is an established therapy for depression, its broader neurological applications remain under active investigation.

Patient Considerations

A standard rTMS treatment course usually involves daily sessions (20–40 minutes) over 4–6 weeks. Common side effects include scalp discomfort, transient headache, or mild dizziness. Serious adverse events, such as seizures, are rare when performed under medical supervision. Patients should undergo proper neurological and psychiatric evaluation to determine suitability.

Author Information

Dr. Hsu-Huai Chiu, Neurologist
Taoyuan, Taiwan
Focus: Neurology, autonomic dysfunction, rTMS
Website: https://drchiuneuro.com/